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HAMILTON AIR QUALITY
DURING THE STELCO STRIKE
AUGUST-NOVEMBER 1981

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The Honourable
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Minister

Gérard J. M. Raymond
Deputy Minister



Ontario

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April 2, 1982

Mrs. J. McAnanama
Hamilton Public Library (Central)
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Dear Sir:

Attached for your information is a copy of a report on Hamilton's air quality during the recent Stelco strike, August to November 1981.

The evaluation of the data was based on a comparison with air quality during a similar time span during 1980, with the effect of weather variability eliminated wherever this was possible.

The results show very marginal overall reductions in concentrations for particulates and slightly larger improvements under specific directional winds from Stelco. There was very good corroboration of results from different evaluation methods. Gaseous concentrations showed significant percentage reductions to the northeast of the plant, but less to the southwest. There was a significant improvement in observed fluoridation rates near Stelco but dustfall showed little change except for some very local conditions.

The report was prepared by Mr. Frank Dobroff, Air Quality Analyst, West Central Region.

For further information, please contact Mr. Dobroff or Mr. Ken Trent, Chief Air Quality Assessment, West Central Region (521-7640). Additional copies of the report are available on request.

Yours truly,

G. H. Mills
Regional Director
West Central Region

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HAMILTON AIR QUALITY DURING THE STELCO STRIKE

AUGUST - NOVEMBER 1981

Ministry of the Environment

Technical Support Section

West Central Region

Hamilton

F. Dobroff and K. E. Trent

March 1982

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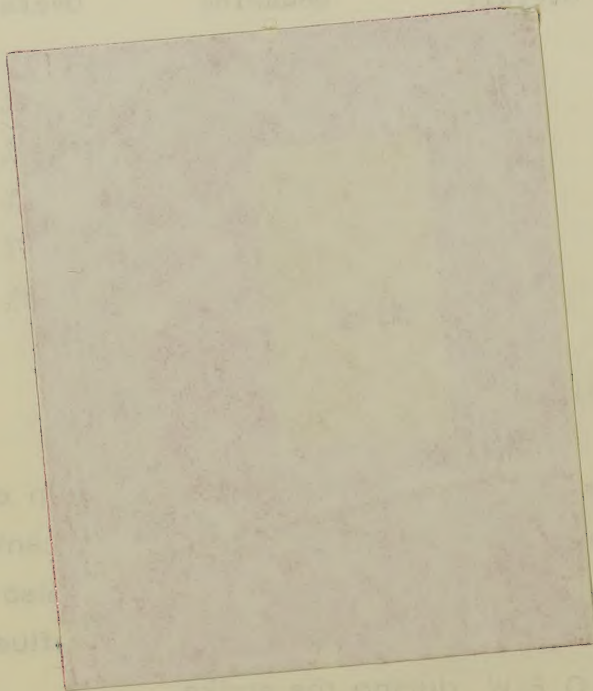
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Results of the city-wide network of dustfall jars indicate that the strike had virtually no effect on dust fallout except in the immediate vicinity of the company, where at one location levels were lower by 20%.

Similarly, the network of fluoridation monitors in the lower city showed no change in levels at some distance from the company such as in the downtown area. However, in close proximity to the plant, levels were significantly lower, showing reductions of 65-75%.

During the strike, there were two incidents in which the Air Pollution Index exceeded the advisory level of 32, one in mid-October, the other in mid-November.



INTRODUCTION

Hamilton's industrial area in the northeast section of the city contains a very dense concentration of air pollution sources. The discharges from these sources are mostly very similar and this has made it difficult to determine the contribution of any one particular source to ambient air quality levels. While mathematical modelling which is based on estimated emissions from the various sources, can give very rough estimates, no determinations through actual measurements have been possible up to now.

On August, 1, 1981, the Steel Company of Canada's Hilton Works went on strike and remained on strike for over four months. This resulted in a shutdown of most of the plant and provided a unique opportunity to observe the effects on Hamilton's air quality by comparing pollutant levels during the strike with levels in a similar non-strike period.

STUDY SCOPE

The bulk of the data utilized was obtained from the two main monitoring stations located at Barton Street and Sanford Avenue (29025) and North Park Avenue on the Beach Strip (29008). The former station lies about 2½ km southwest of Hilton Works while the latter lies about 2 km northeast as shown in Figure 1.

The pollutants from these stations which were evaluated were: particulates (both soiling index and suspended particulates), the iron content in suspended particulates and two gases - sulphur dioxide and nitrogen dioxide. In addition, the city-wide networks of dustfall and fluoride monitors were also examined. Wind direction and wind speed data measured at the Woodward Avenue sewage treatment plant were used.

Several pollutants measured at the two stations were excluded either due to the fact that the pollutant was mostly unrelated to Stelco emissions, such as ozone, or occurs in such low concentrations that it is of minor concern, such as carbon monoxide. Other pollutants not evaluated were those related to traffic emissions such as carbon monoxide and nitric oxide.

Total reduced sulphur compounds (TRS) the substances which can create odour problems were also eliminated from the evaluation. During the on-going month by month analysis during the strike, TRS was studied similarly to soiling index, sulphur dioxide and nitrogen dioxide. However, the results for this pollutant were quite variable due to the sometimes intermittent nature of their emissions. In many cases, emissions of these gases are the result of upset conditions due to equipment failures or other sudden releases. Whether or not the monitors detect these discharges is dependent on the wind direction and other meteorological parameters. This variability is reflected in yearly averages since 1975, which have fluctuated widely at the two stations. In addition, some 1981 data is still outstanding and instrumentation problems resulted in some lost data. Comparisons could therefore not be readily made.

It should be realized that the conclusions reached concerning the Barton/Sanford and North Park station's results cannot necessarily be applied to other locations in the city. Air quality and Stelco's contribution to it, varies from place to place. However, the two stations are strategically placed so as to be good monitors of the industrial area. The North Park station under prevailing conditions is downwind of the industries since winds predominate from the southwest while the Barton/Sanford station lies downwind of the industries during periods of limited atmospheric dispersion, that is, very light northeast winds, which are sometimes associated with inversions.

TIME PERIOD OF COMPARISON

The four month strike period from August to November, 1981 was compared to the same time interval in 1980. Seasonal fluctuations in pollutant levels precluded comparison with other time periods.

WEATHER VARIABILITY

As mentioned previously, pollutant levels can vary seasonally. It is also known that weather conditions can greatly influence pollutant concentrations. It will be shown that weather variability between the two time periods of comparison have been accounted for where possible. Therefore, the conclusions concerning the strike's effects should be reasonable and exclusive of weather variations in most cases.

STELCO ACTIVITIES DURING THE STRIKE

Although steel production during the strike was nil, certain operations had to be maintained to avoid damage to installations. Furnaces had to be kept up to temperature and there was also a limited amount of coke production. Particulate emissions were estimated to have been about 6% of those during normal operations while sulphur dioxide emissions during the strike were approximately 17% of those during normal production. There is of course also a certain amount of dust blowoff continuously present from various stockpiles, roadways and parking lots, although the quantities were significantly reduced as a result of reduced activities on the mill site. As those emissions are considered fugitive it is impossible to compare their contribution before and during the strike.

ANALYSIS OF HOURLY DATA - Soiling Index (COH), sulphur dioxide and nitrogen dioxide at Barton/Sanford and North Park.

Method

The hourly data were analyzed by two methods. Firstly by averaging concentrations during the hours when the wind blew specifically from Stelco to the monitoring station and secondly by taking overall averages, regardless of wind direction.

The Stelco winds (or "critical" wind sectors) utilized were:

Barton/Sanford:	30-80°
North Park:	220-270°

The concept of "critical" and "non-critical" winds are illustrated in Figure 2. As can be seen, the "critical" wind sectors result in a certain amount of overlap with neighbouring companies.

For the directional analysis, those hours with wind speeds less than 4 km/h were eliminated. Winds with such low speeds do not yield reliable directional data.

In order to isolate the strike's effect from other effects (mainly weather), a weather correction term was calculated from the change in the "non-critical" averages. The "non-critical" averages were determined simply by removing the "critical" wind average from the overall average. This new "non-critical" average represents the pollutant concentrations when the wind blew in all directions except those from Stelco. Any change in this average was assumed to be entirely independent of the Stelco strike and is referred to as the weather effect. One difficulty remaining however was that this overall weather effect at the two stations was only represented by the "non-critical" wind sectors. To include the "critical" wind sectors the averages during "critical" winds at the opposite or sister station were utilized. That is, for Barton/Sanford the averages during "critical" winds (30-80°) were determined at North Park and for North Park's "critical" winds (220-270°), Barton/Sanford data were used. These "critical" averages were then integrated with the "non-critical" wind data to give the full overall weather effect at each station.

The weather effect during "critical" winds was simply the percentage change at the opposite station during these winds.

Another necessary refinement was normalization of the true overall average due to varying frequency of critical winds from the 1980 and 1981 periods. As an example, a change in a pollutant average from one period to the next could be due to a change in frequency of winds from a certain direction. In the case of Barton/Sanford, this procedure was academic since there was little difference in the frequency of northeast winds in August-November 1980 and 1981 (10.3% and 14.7% respectively). However, normalization was necessary for North Park due to a wide difference in the frequency of southwest winds between the 1980 and 1981 periods (27.2% and 16.8% respectively).

The final step in this analysis was the calculation of the effects of the strike on the pollutant averages during "critical" wind conditions as well as overall, with subtraction or addition of the weather effect.

To simplify matters, the averages were converted to percentages with the 1980 averages considered to represent 100%.

The calculation for North Park soiling index serves as an example:

Units: COH's/1000 ft. of Air

	Critical Average (winds from Stelco)	Overall Average (normalized)	Weather Correction On Overall Average	Weather Correction On Critical Wind Average*
1981	.795	.64	.633	.406
1980	1.076	.83	.734	.389
Converting to percentages;				
1981	74	77	86	104
1980	100	100	100	100
measured at Barton/Sanford				
			-14	+4

The strike effect general formula is;

(1980 average - 1981 average) + weather effect

For critical winds: $100 - 74 + 4 = 30\%$ decrease

and overall: $100 - 77 + (-14) = 9\%$ decrease

RESULTS

Soiling Index

Tape samplers operate continuously and determine hourly averages at Barton/Sanford and North Park. Air is drawn through a filter paper and the optical density of the soiled spot is measured by light transmittance. Mostly very fine particulate matter is sampled.

Both Barton/Sanford and North Park showed decreases in soiling index which could be attributed to the strike (Table 1a).

At Barton, the levels were lower by 2% overall and 12% when the station was downwind of Stelco.

At North Park, the decreases were 9% and 30% respectively.

As can be seen, the decrease under critical winds was much greater at North Park than Barton. This could be due to a number of factors such as the open terrain between the North Park station and the Stelco complex. However, the main factor is probably traffic on the Q.E.W., a major highway. The North Park station lies immediately adjacent to this highway. Critical winds carry not only Stelco emissions to the station but also highway emissions. Although detailed traffic counts were not available, there was probably a significant decrease in traffic, especially truck traffic, during the strike and this may have served to add to the decreases measured at the station. The dustfall results at this station (to be discussed in a following section) seem to corroborate this theory.

The overall change due to the strike was also much greater at North Park than Barton. This is logical, since winds predominate from the southwest

in this area and thus place North Park in a receptor position more frequently.

Sulphur Dioxide (SO_2)

Large decreases in SO_2 attributable to the strike were noted at both Barton and North Park under "critical" winds (Table 2). Overall effects at the two stations varied.

Barton showed no decrease at all overall but was lower by 28% when downwind of Stelco.

North Park was lower by 17% overall and 41% when downwind.

Significant decreases were expected since Stelco accounts for roughly 40% of all SO_2 emissions in the city.

It must be stressed, however that sulphur dioxide is not a problem pollutant in Hamilton. Concentrations are normally very low, and ambient air criteria are rarely even approached. This is borne out by the lack of any overall effect at Barton.

Winds predominate from the southwest, and hence an overall effect was observed at North Park.

Nitrogen Dioxide (NO_2)

The two stations showed quite opposite results. Barton showed no decrease at all attributable to the strike, both overall and when downwind of Stelco, while North Park showed large drops, 37% and 62% respectively (Table 2).

Nitrogen dioxide is not a direct emission. Rather, high temperature combustion of fuels produces nitric oxide (NO) first, which is later oxidized to NO_2 in the atmosphere. This reaction can take time and therefore it is nearly impossible to determine the origin of the pollutant from a complex of numerous sources. This makes any directional analysis somewhat unreliable, particularly in view of the fact that Stelco accounts for roughly only 10% of all emissions of oxides, of nitrogen in the city.

Similar to sulphur dioxide, nitrogen dioxide is not a problem pollutant in Hamilton. Concentrations are normally very low, with ambient air criteria rarely approached.



ANALYSIS OF DAILY DATA

Suspended Particulates (by Hi-vol)

A high volume sampler consists of a housing containing a vacuum motor which draws a known volume of air through a pre-weighed filter for 24 hours (midnight to midnight). The exposed filter is weighed and the weight difference in conjunction with the air flow is expressed as a concentration in micrograms per cubic metre. The filters can then be chemically analyzed for various constituents, such as heavy metals. The particulate matter sampled contains a much larger size range of particles than the soiling index measurement. At Barton/Sanford and North Park, these devices run daily, while at all other locations they run on a once every sixth day cycle.

Method of Analysis

Due to the large number of samples obtained at Barton and North Park, this data could be analysed on a wind direction basis, similar to the hourly data. Both total suspended particulates and the iron content were analysed.

For the 1981 strike and the corresponding period in 1980, a predominant wind direction was determined for each day. This was done by counting the number of hours of winds from the eight cardinal wind directions (N, NE, E, etc.). For those days when at least 18 hours of wind occurred from 3 or less adjacent wind sectors, a predominant daily direction relating to 16 points was assigned (NNE, NE, ENE, etc.). As with the hourly data, those hours with wind speeds less than 4 km/h were considered as calm, the direction figure considered unreliable, and these values omitted in the evaluation.

The assumed "critical" wind directions (winds from Stelco) were:

- | | | |
|----------------|---|-----------------|
| Barton/Sanford | - | NNE, NE and ENE |
| North Park | - | SW, WSW, and W |

Those samples which occurred under critical wind days were tabulated and averaged, excluding those samples which occurred on or immediately following a day with more than 5 mm of rainfall (as measured at Mt. Hope airport).

In order to isolate the strike effect from other effects (mainly weather) a weather correction term was calculated for the overall average and the "critical" wind average similar to that described previously for the hourly data.

As with the hourly data, the North Park overall 1981 average had to be normalized due to the higher frequency of southwest winds in 1980.

The final step in the analysis was the calculation of the strike effect on the suspended particulate averages during "critical" wind conditions as well as overall with subtraction or addition of the weather effect as appropriate. To simplify, the averages were converted to percentages, with the 1980 average considered to represent 100%.

Results

The suspended particulate data showed remarkably similar results to those of soiling index.

Both Barton/Sanford and North Park showed decreases which could be attributed to the strike (Table 1a). At Barton, the levels were unchanged overall but were lower by 10% when downwind of Stelco. North Park showed a 9% decrease overall and a 22% drop when downwind.

Explanations for these results are similar to those for the soiling index results.

There are eleven other hi vol stations located throughout the city, (Figure 5) but they run on an every sixth day cycle. The small number of samples for each during the two periods of comparison does not allow for a directional study, but overall, the composite average of all thirteen stations reduced to 66 ug/m^3 during the 1981 strike, from 72 ug/m^3 in 1980; a reduction of 8%, as given in Table 1c. Rainfall was accounted for

by excluding those samples which occurred on or immediately following a day with more than 5 mm of rainfall.

Iron concentrations in suspended particulate at the two main stations were included in the analysis because Stelco is one of the major sources of this metal, making this a good indicator pollutant of the strike.

North Park showed decreases similar to suspended particulates and soiling index; 7% overall and 31% when downwind.

However, Barton showed no decrease at all attributable to the strike both overall and when downwind. The lack of a decrease in iron for the overall results is not surprising in view of the values for the other particulate measurements, however, the lack of a percentage decrease under downwind conditions was rather unexpected and is not readily explained. It is possible that the correction term for weather may have been exaggerated when expressed in terms of percentage due to the comparatively small size of the 1980 and 1981 averages (as measured at North Park). To illustrate, the averages during northeast winds at North Park (ie. the correction term) decreased from only 2.3 ug/m^3 to 1.1 ug/m^3 or 52%. The averages during critical northeast winds at Barton decreased from 10.0 ug/m^3 to 6.1 ug/m^3 or 39%. Thus, while the actual decrease in terms of magnitude was over three times greater than the weather correction term, the latter still outweighed the actual decrease in terms of percentage.

Therefore, it is reasonable to infer that the strike did have an effect on lowering iron levels at the Barton/Sanford location when the station was downwind of Stelco.

MONTHLY DATA - DUSTFALL AND FLUORIDATION RATES

Dustfall

Dustfall is that material which settles out of the atmosphere by gravity and is collected in plastic containers during a 30 day exposure time. The collected material is weighed and expressed as a deposition rate of grams/square meter/30 days.

There are twenty dustfall locations scattered throughout the city (Figure 3) but one location was severely affected by construction activities during the strike and had to be eliminated from the analysis. Data is presented in Table 3. Dustfall concentrations generally originate only from local sources. Each dustfall jar location is really only indicative of a relatively small area, say one or two city blocks since heavy particulate emissions do not travel very far except under very strong winds.

The true effect of the strike can only be properly measured at station 29011 on Leeds Avenue, just off the company property. The average here decreased by 20% during the strike. However, the station may have been influenced by other nearby non-Stelco sources whose emissions were also reduced due to the strike.

Overall, for all other locations in Hamilton, the average changed very little, and actually showed a slight increase during the strike from 7.7 grams in 1980 to 8.2 grams during the strike. In other words, the strike had no effect on particulate fallout except in the immediate vicinity of the company.

As mentioned, one station (29010) on Ottawa Street near Burlington showed extremely high concentrations during the strike, about double the norm. This was caused by construction of a new hot strip mill at Dofasco in the immediate vicinity of the monitor. The construction and excavation activities plus abnormally high traffic continued throughout the strike and up to the present time. These observations serve as a good illustration of just how local an area each monitor represents.

The effect of a traffic reduction on the Q.E.W. was borne out by the North Park (29008) results. Concentrations here dropped 39% from 1980. This drop was probably due entirely to the Q.E.W. Another station only about two blocks away (29084) on Beach Blvd. showed no change.

It must be noted that the dustfall measurement is very inexact and can be influenced by numerous factors. Definite conclusions can therefore not be made. The fact that the measurement is a monthly one, also made it impractical to apply a weather correction.

Fluoridation

Fluorides are measured by lime-coated filter papers exposed to the atmosphere for about 30 days. The sample is then chemically analysed for fluorides.

There are eleven fluoride monitors scattered throughout the lower city as shown in Figure 4. On average, the levels during the strike were about 37% lower than in 1980 with the greatest decreases being found on the Beach Strip (29008, 29058, 29066), and in the industrial area (29059) where levels dropped 65-75% (Table 4) to just marginally above criteria. Further away downtown (29001, 29025) the levels were unchanged and below criteria.

Stelco is a major source of fluorides and most of the emissions are in particulate rather than gaseous form, which limits the extent of the area of influence. As with dustfall, the fluoride measurement is very inexact and can be influenced by numerous factors. Due to the measurement being monthly, a weather correction term could not be applied.

AIR POLLUTION INDEX (API)

It is noteworthy that during the strike the Air Pollution Index (measured at Barton/Sanford) equalled or exceeded the advisory level of 32 on two occasions - October 14 - 15 and November 14 - 15. The index exceeded 31 for 19 hours during the October incident and for 43 hours during the November incident reaching maximums of 34 and 38 respectively. Both incidents were the most prolonged of the year and were due mainly to the stagnation of a high pressure cell over the area. This created a widespread temperature inversion and resulted in elevated pollutant levels throughout Southern Ontario. During the November incident, the Toronto API reached 43 and Windsor 38.

These results further indicate the severe effect meteorological conditions can have on Hamilton's air quality, even during the shutdown of one of the largest pollutant sources.

CONCLUSIONS

The main pollution problem in Hamilton is airborne dust. Particulate levels in certain parts of the city, mainly near the heavy industry, remain unsatisfactory.

The Stelco strike analysis indicated that Stelco's contribution to fine particulate levels varies depending on location and whether short or long term effects are considered.

The effect on long term averages were reductions varying from about 2% upwind of the plant at Barton/Sanford to less than 10% downwind at North Park with respect to the predominant southwest winds in this area.

Short term reductions, specifically, downwind of Stelco at any given time, were of course larger. The two main stations showed drops of 10% during the strike at Barton/Sanford and 20-30% at North Park when directly downwind of Stelco, although North Park may have been additionally influenced by a reduction of heavy truck traffic on the Q.E.W.

The fact that two entirely different methods of measurement, soiling index and high volume sampling, found similar effects tends to corroborate the results.

Overall, the composite average of all suspended particulate monitors decreased by 8%.

Iron concentrations in suspended particulate showed similar decreases to the other particulate results at Barton/Sanford and North Park.

The analysis indicated that the strike had virtually no effect on dust fallout throughout the city, except in the immediate vicinity of the plant where a 20% reduction took place during the strike.

The fluoride levels were generally unaffected except in the immediate vicinity of Stelco where reductions of 65-75% were observed. This confirms the knowledge that much of the fluoride measured in Hamilton is in particulate form.

The strike generally did not have a significant effect on gaseous pollutants. While the percentage change was significant in some cases, especially at the North Park station, the actual decrease was relatively small because levels were low to begin with.

FIGURE 1
LOCATION OF BARTON/SANFORD
AND NORTH PARK RELATIVE TO
STELCO

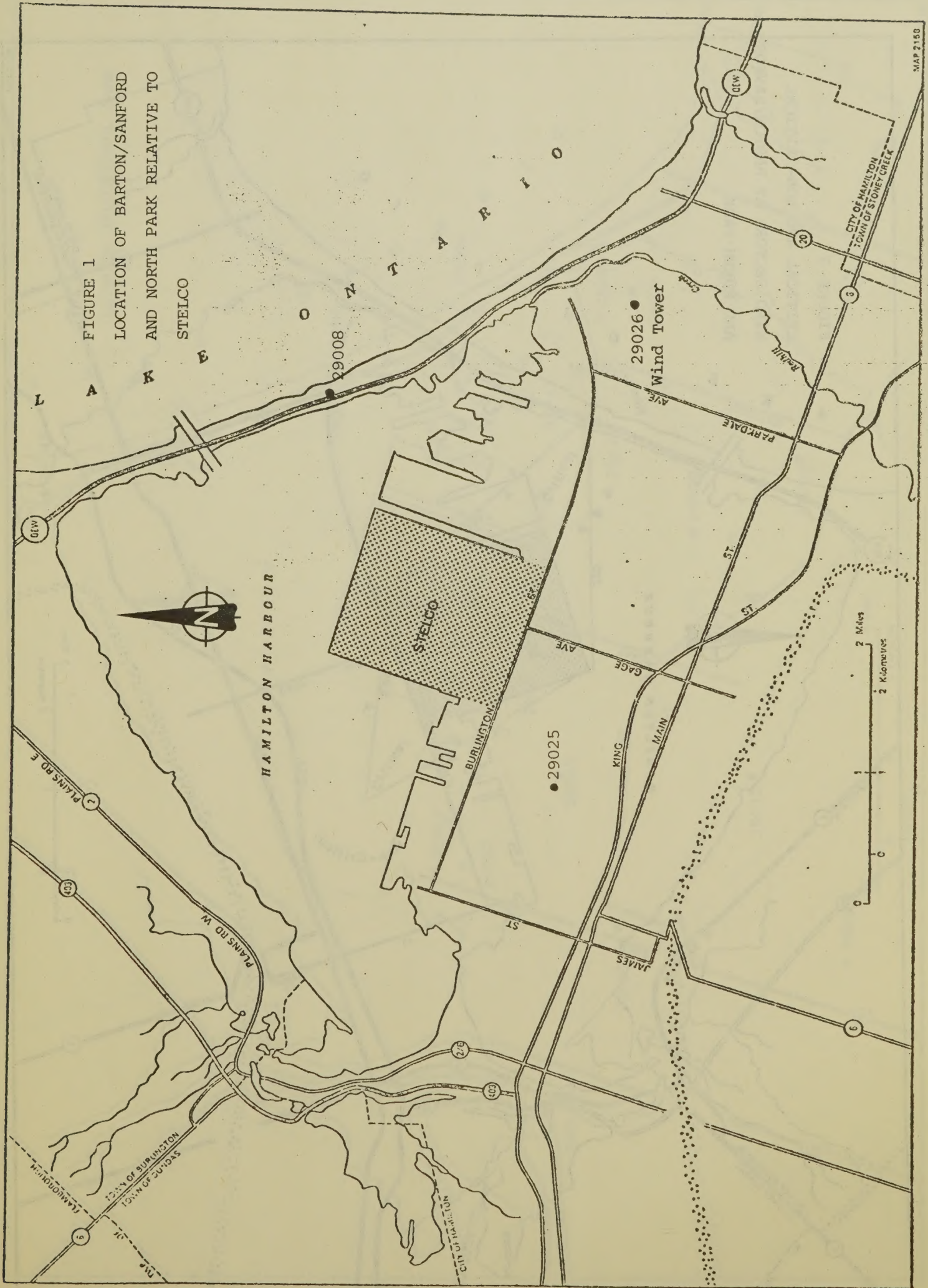


FIGURE 2

CRITICAL AND NON-CRITICAL

WIND SECTORS AT BARTON/SANFORD

AND NORTH PARK

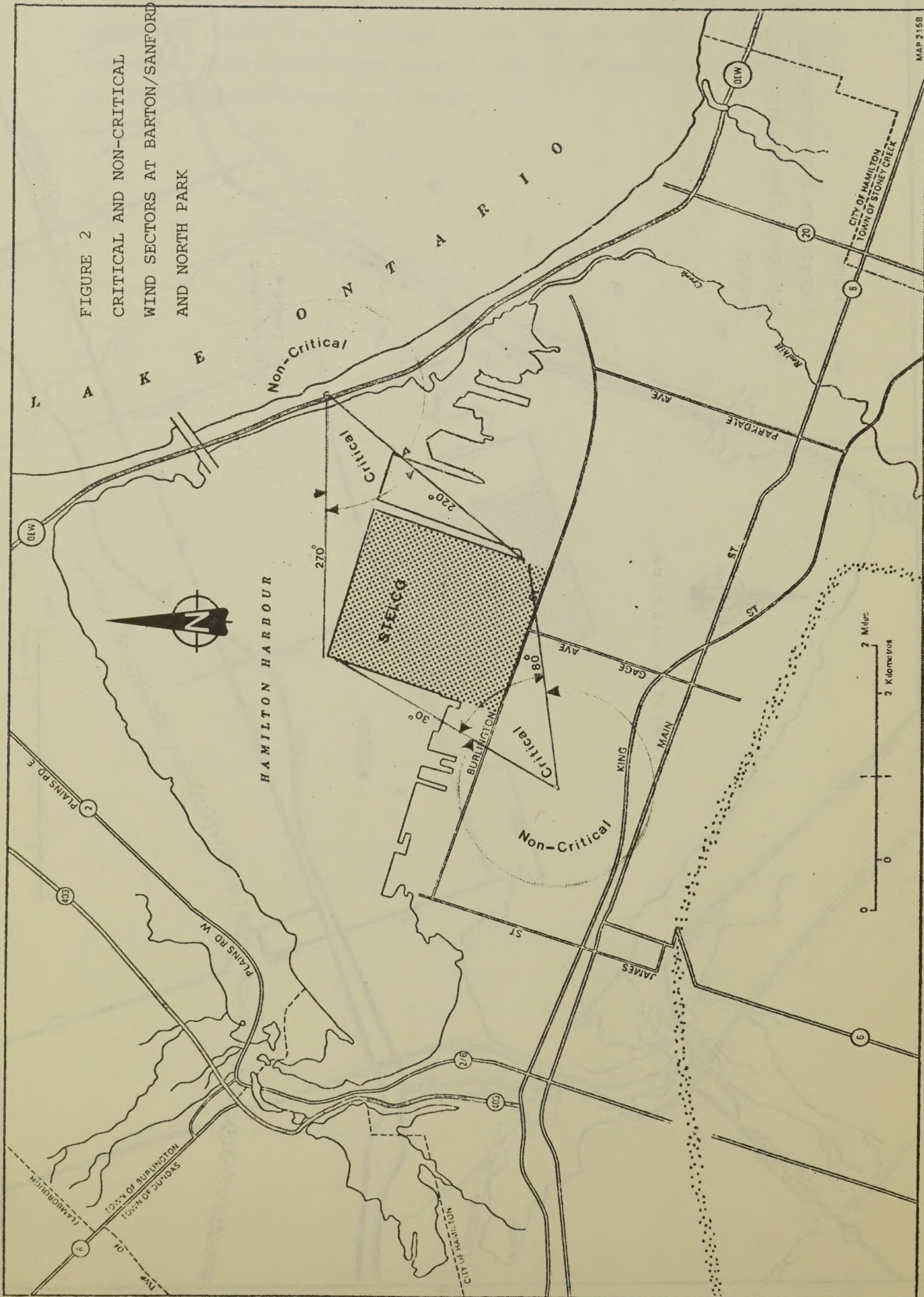


FIGURE 4
NETWORK OF FLUORIDE MONITORS

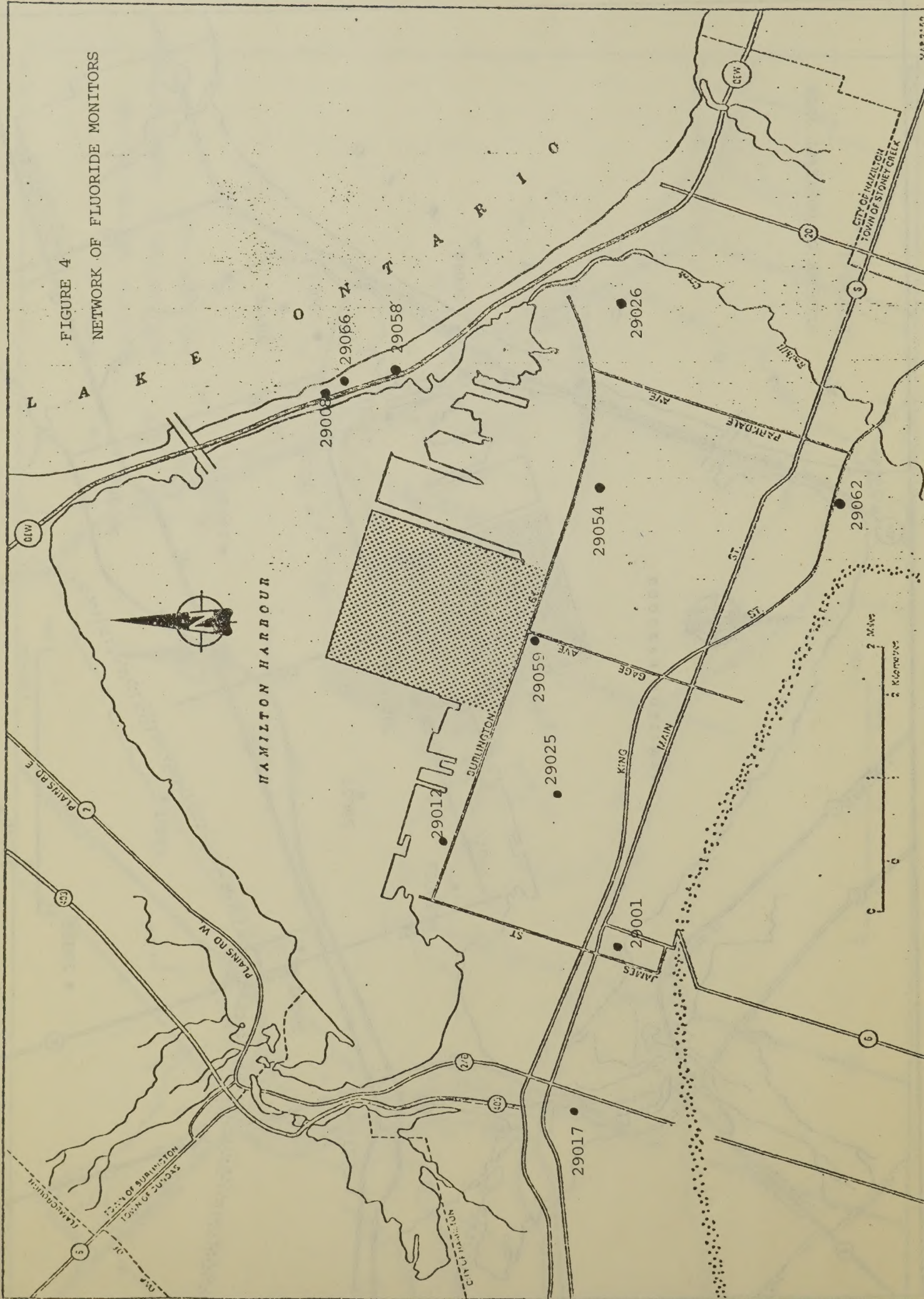


FIGURE 5
NETWORK OF HIGH VOLUME SAMPLERS

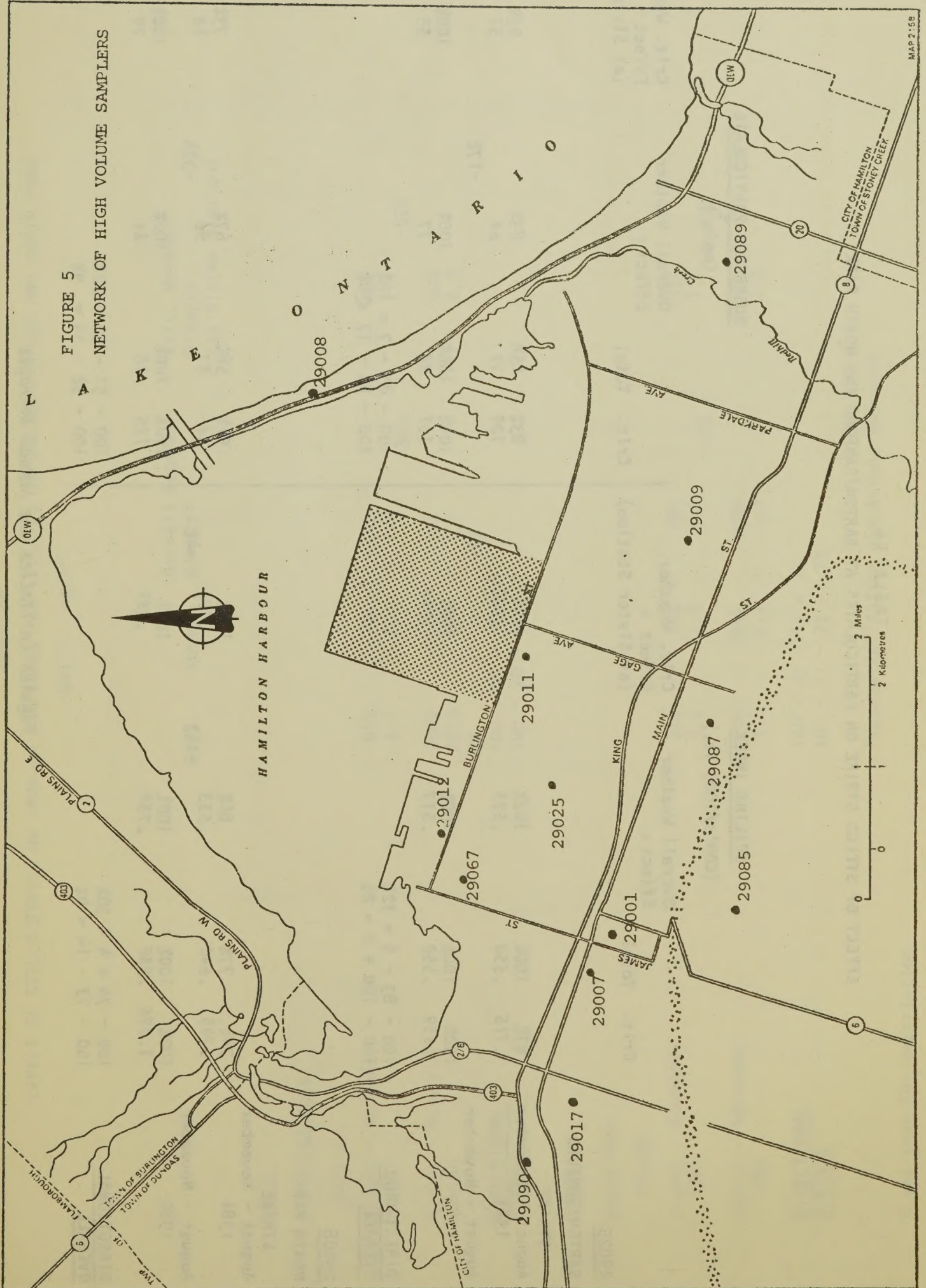


TABLE 1 A

EFFECT OF STELCO STRIKE ON PARTICULATES AT BARTON/SANFORD AND NORTH PARK

		SOILING INDEX (COH's/1000 ft.)		SUSPENDED PARTICULATE ($\mu\text{g}/\text{m}^3$)		
		Overall Weather Effect *	Crit. Weather Effect * (at Sister Station)	Crit. Total	Overall Weather Effect *	Crit. Weather Effect * (at Sister Station)
29025						
BARTON/SANFORD						
STRIKE						
August - November	1981	102% .525	95% .232	83% 109	83% 64	93% 51
August - November	1980	+2%	-5%	71	-17%	-7%
DIRECTIONAL						
OVERALL		100% .550	100% .244	100% 131	100% 77	100% 55
		100 - 83 - 5 = 12%		100 - 83 - 7 = 10%		- 24 -
		100 - 100 + 2 = 2%		100 - 85 - 17 < 0%		
29008						
NORTH PARK						
STRIKE						
August - November	1981	86% .633	104% .406	51% 64	67% 56	73% 58
August - November	1980	-14%	+4%	57	-33%	-27%
DIRECTIONAL						
OVERALL		100% .734	100% .389	100% 125	100% 84	100% 79
		100 - 74 + 4 = 30%		100 - 51 - 27 = 22%		
		100 - 77 - 14 = 9%		100 - 58 - 33 = 9%		

Figures in Italics are Actual Averages

* see text for description

TABLE 1B

EFFECT OF STELCO STRIKE ON IRON IN SUSPENDED PARTICULATES AT BARTON/SANFORD AND NORTH PARK

UNITS - ug/m³

		Crit.	Total	Overall Weather Effect*	Crit. Weather Effect* (at Sister Station)
<u>29025</u>					
BARTON/SANFORD					
STRIKE					
August - November 1981	61% 6.1	70% 2.6	64% 1.8	48% 1.1	-52%
August - November 1980	100% 10.0	100% 3.7	100% 2.8	100% 2.3	
DIRECTIONAL OVERALL	100 - 61 - 52 < 0 100 - 70 - 36 < 0				
<u>29008</u>					
NORTH PARK					
STRIKE					
August - November 1981	22% 2.0	21% 1.4	28% 1.5	53% 1.0	-47%
August - November 1980	100% 9.2	100% 6.6	100% 5.3	100% 1.9	
DIRECTIONAL OVERALL	100 - 22 - 47 = 31% 100 - 21 - 72 = 7%				

Figures in Italics are Actual Averages

* see text for description

TABLE 1C
SUSPENDED PARTICULATE - ARITHMETIC AVERAGES*
August - November
1980 vs 1981

Micrograms per cubic metre

		1980	1981 STRIKE
29001	Hughson/Hunter	64	57
29007	City Hall	53	59
29008	North Park	105	58
29009	Kenilworth/Roxborough	49	66
29011	Burlington/Leeds	108	88
29012	Burlington/Wellington	69	68
29017	Chatham/Frid	84	75
29025	Barton/Sanford	91	81
29067	Hughson North	58	55
29085	Mountain Police	51	59
29087	Cumberland/Gage	58	72
29089	Barton/Nash	68	64
29090	Westdale	76	58
overall average		72	66

* Averages exclude those samples which occurred on or immediately following a day with more than 5 mm of rainfall

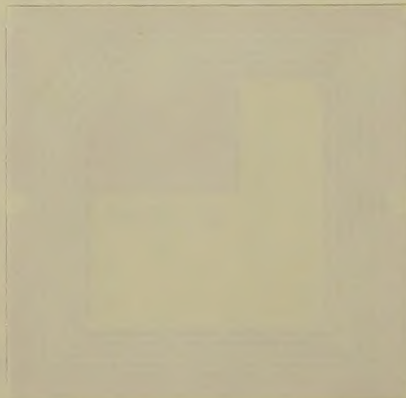


TABLE 2

EFFECT OF STELCO STRIKE ON SO₂ AND NO₂ AT BARTON/SANFORD AND NORTH PARK

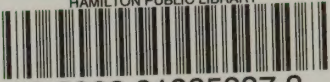
	SO ₂ (pphm)			NO ₂ (pphm)		
	Crit. Total	Overall Weather Effect *	Crit. Weather Effect * (at Sister Station)	Crit. Total	Overall Weather Effect *	Crit. Weather Effect * (at Sister Station)
<u>29025</u>						
BARTON/SANFORD						
STRIKE						
August - November 1981	81% 2.07	70% .70	68% .57	109% .35	130% 3.00	128% 2.86
August - November 1980	100% 2.56	100% 1.00	100% .84	100% .32	100% 2.30	100% 2.23
DIRECTIONAL	100 - 81 + 9 = 28%					
OVERALL	100 - 70 - 32 < 0%			100 - 120 - 2 < 0%		
				100 - 130 + 28% < 0%		
<u>29008</u>						
NORTH PARK						
STRIKE						
August - November 1981	35% .82	53% .80	70% .81	76% .25	86% 2.50	123% 2.36
August - November 1980	100% 2.33	100% 1.50	100% 1.16	100% .33	100% 2.90	100% 1.92
DIRECTIONAL	100 - 35 - 24 = 41%					
OVERALL	100 - 53 - 30 = 17%			100 - 54 + 16 = 62%		
				100 - 86 + 23 = 37%		

Figures in Italics are Actual Averages

* see text for description



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